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ABSTRACT

A review of the research literature on the effectiveness of remedial mathematics programs in two-year colleges is presented. Although remediation programs vary from one college to another, they share some common characteristics. Most programs include a placement component, two or three courses in arithmetic and algebra, and support services like tutoring, laboratory activities, and counseling. Objectives usually include helping the student to: (1) acquire basic arithmetic and algebra skills; (2) become mathematically literate; (3) gain confidence and self-respect in mathematics; (4) develop positive attitudes toward mathematics; and (5) prepare for further studies in mathematics or for entry into technical, vocational, or business programs. Attempts to evaluate these programs tend to either focus on specific objectives, like the extent to which remedial courses prepare students for further studies in mathematics, or on the evaluation of instructional strategies themselves. Although it is known that remedial programs provide students with essential skills in arithmetic and elementary algebra and that certain instructional methods promote positive attitudes, studies provide conflicting evidence about the effectiveness of the programs and the most appropriate of the 16 studied instructional strategies. (MB)

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A REVIEW OF RESEARCH ON THE EFFECTIVENESS OF REMEDIAL MATHEMATICS PROGRAMS IN TWO YEAR COLLEGES

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Presented at the Annual Meeting of the American Mathematical Association of Two Year Colleges (Houston, Texas, October 10-14, 1978).

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If the results of a recent national survey (Baldwin et al., 1975) are representative of the situation, then virtually all two year colleges in this country offer remedial courses in mathematics. Although the percentage of students requiring remedial assistance is generally small, (< 20%), the severity of these students' deficiencies in mathematics forces many colleges to offer courses in arithmetic and elementary algebra, using a variety of media and methods. How effective these programs are is still an open question since, as recently as three years ago, "evaluation of existing programs was just about non-existent" (Baldwin et al., 1975). The purpose of this paper is to provide information that will bring the reader up-to-date on studies that have been done on the remedial programs.

Although remediation programs vary from one college to another, they share some common characteristics. Most programs include a placement component, two or three courses in arithmetic and algebra, and support services like tutoring, laboratory activities and counseling. Objectives usually include helping the student to:

1. acquire basic arithmetic and algebraic skills,
2. become mathematically literate,
3. gain confidence and self-respect in mathematics and
4. develop positive attitudes toward mathematics.

One other goal of remedial mathematics is to prepare the student for further studies in mathematics or for entry into technical, vocational or business programs (Baldwin, 1974; Beal, 1970; and Kipps, 1966).

Attempts to evaluate these programs have, in general, taken two forms. Some evaluators focused on specific objectives like the extent to which remedial courses prepare students for further studies in mathematics. Studies of this type done in New York, for example, examined the failure rate of students who had progressed from a remedial course in trigonometry to a beginning course in calculus. While the remedial students had an alarming failure rate of 77%, students of a comparable degree of readiness, who did not have the benefit of remediation, had an even higher failure rate of 81% (Berger, 1971).

This result agrees with the findings of similar studies done at two separate colleges. In one of these studies, Clark (1967) concluded that while remediation adequately prepared students for low level mathematics courses, it did not sufficiently prepare them for college-level courses such as precalculus mathematics. The other study (Ottley, 1967) also indicated that while the performance of remedial student in their first precalculus course was not significantly different from that of non-remedial students, it was nevertheless poor.

These findings, however, do not quite agree with those of Tekel (1974) who observed the performances of two random samples of remedial students in college mathematics courses. One sample

(N_1 = 56) consisted of students who, having completed a prescribed program in mathematics, were judged to be prepared for the college-level courses. The other sample (N_2 = 56) consisted of "unprepared" students, who had skipped the last in a series of three developmental mathematics courses offered at the college. Thirty-one of the prepared and 21 of the unprepared students later registered for higher level courses. Only 6 (approximately 29%) of the 21 unprepared students passed the courses while 23 (approximately 74%) of the prepared group received passing grades.

In a similar study, Moore (1974) compared the grades received by 77 remedial students in six subsequent courses with those of non-remedial students. Even though remedial students earned better grades in three of the courses, Moore concluded that the remedial program he studied "was not entirely successful" in preparing students for non-remedial college mathematic courses.

Studies of Instructional Strategies

In an effort to better meet the needs of remedial students, mathematics instructors in two year colleges have adopted teaching methods used in public shcools and even created a few of their own. The report on the survey cited earlier (Baldwin et al., 1975) listed 16 different methods that have been used in teaching remedial mathematics. Expecting that the methods would have varying degrees of effectiveness, many researchers conducted studies to determine the merits of each approach. The

two most popular methods -- the traditional and programmed, have therefore featured in a series of studies designed to measure their effects on academic achievement.

In one of these studies, Beck (1970) found the traditional method to be superior to the programmed one when used with students in remedial algebra. Both methods, however, seemed to have the same effect on retention. Conroy (1971) on the other hand, found no significant differences between the two methods. Like Conroy, Nott (1971) also found little difference between the two methods. But he cautioned that students with serious difficulty in mathematics or reading may have greater difficulty with a programmed approach than with the conventional way. In still another comparative study of the two methods, White (1969) discovered that even though the two approaches are equally effective in teaching problem-solving, the programmed method may be better for teaching computational skills.

The traditional method has also been compared with a number of other methods such as the audio-tutorial (Millsaps, 1975; and Morman, 1973), contract method (Miller, 1974), a "systems approach" (Carr, 1976), tutorial approach (Chen, 1975; and Weber, 1970) and televised instruction (King, 1959). However, none of these methods produced superior achievement in arithmetic, algebra or analytic geometry than the traditional method.

Even when used in a mastery learning situation, the traditional method seemed to be as effective as tutorial and audio-tutorial methods (Baley, 1972). In itself, however, the method was not as effective as mastery learning strategy (Reese, 1976).

The laboratory and modular approaches and small group instruction were suggested as viable alternatives to the traditional method of instruction. Research evidence (Papandrea, 1974) however, suggests that the traditional academic approach produces higher achievement in mathematics than the laboratory method. In another study, small group instruction proved to be more effective than the traditional approach when both methods were supplemented by laboratory procedures (Slate, 1975). Similarly, a personalized system of instruction turned out to be more efficient than the traditional way (Akst, 1976).

Researchers have also studied the effectiveness of some of the lesser known methods of instruction. One such study (Lieblich, 1976) indicates that the tutorial approach is superior to the programmed approach. Houston (1977) found that academic performance could be improved by presenting students with instructional objectives.

Very little is known about what effect the mode of remedial instruction may have upon future performance in mathematics. A study by Corn and Behr (1975) suggests that the method used to teach remedial mathematics may affect student performance in subsequent mathematics courses. In their study, the two researchers compared the performances of three groups of students, who had been taught remedial mathematics earlier, each group by a different method. They found that students who received remedial instruction via the conventional, lecture-discussion

method did better in a subsequent mathematics course than students who had been taught with either the programmed or the modular approach.

One important aspect of remediation that has also been examined is the effect of various teaching methods on the attitude and self-concept of the student. The results of several studies indicate that tutoring students (Carman, 1975), using lecture-demonstration methods (Randall, 1972), small group instruction, or mastery learning approach (Slate, 1975) could improve student attitudes toward mathematics. Miller (1974), however, found no evidence that the lecture-discussion method could produce such change in attitude.

Conclusion

Although developmental mathematics programs have received an appreciable amount of research attention, we still do not have sufficient information to determine how effective these prorams are. It is known that the programs provide students with essential skills in arithmetic and elementary algebra. We also know that certain instructional methods tend to promote positive changes in students' attitudes toward mathematics. But on other important questions, we are still in the dark. We can not afford to remain much longer in the dark.

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